PROCESS AND APPARATUS FOR FORMING IMAGES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an image forming process for forming a protective layer of a thermoplastic resin film on a recording medium and an image forming apparatus for carrying out this process.

Related Background Art

[0002] In recent years, ~~the progress of~~ the TECHNIQUE OF ink-jet recording ~~technique is~~ HAS MADE noteworthy PROGRESS AND THE RESULTANT IMAGE ~~and its image~~ quality has reached a level equal or superior to that of a silver halide print. ~~As to~~ A KNOWN recording media used for this ink-jet recording process, ~~those with~~ INCLUDES an image-receiving layer ON A BASE MATERIAL SUCH AS PAPER. THIS LAYER containing porous particles excellent ~~in~~ AT absorbing and fixing recording liquid, ~~provided on a base material such as paper, are known.~~

[0003] ~~Besides~~, ALSO UTILIZED IS a laminating treatment of a recorded ~~image~~ IMAGE WHICH PROVIDES WATERPROOF CHARACTERISTICS, LIGHT RESISTANCE AND GLOSSINESS, THIS TREATMENT IS ACHIEVED by transferring and laminating a transfer layer, ~~which is~~ COMPRISED OF A LAYER OF comprising a thermoplastic resin ~~layer provided~~ on a base material, onto a recorded image by heat and pressure adhesion, ~~to give waterproof, light resistance, glossiness, etc. is also known~~. By having a UV absorbing agent contained in the transfer layer during this treatment, it is also possible to provide ~~a~~ A PRINT WITH sufficient light resistance ~~to a print~~. Furthermore, ~~by devising the material and constitution of this~~ CONSTRUCTION

~~transfer layers~~, many RESIN-USING laminating treatments of an image ~~HAVE BEEN WORKED OUT USING A RESIN~~ HAVE BEEN ESTABLISHED FOR ~~for simply and~~ easily providing ~~the~~ wear resistance, BY DEVISING THE MATERIAL AND CONSTRUCTION OF THIS TRANSFER LAYER. solvent resistance, or the like ~~by use of a resin have been worked out thus far.~~

[0004] FIGS. 3A to 3C are schematic sectional views of a conventional laminating method. The film with a base material shown in FIG. 3A basically comprises a transfer layer 101 to be transferred and laminated onto the surface of a recorded image and a base material film 102 for bearing the transfer layer 101. The transfer layer 101 can be peeled off from the base material FILM 102 so as to be transferred and laminated onto the image-receiving layer of a recording medium after recording.

[0005] As shown in FIG. 3B, the transfer layer 101 is laminated while remaining borne on the base material film 102 ~~so as to~~ THE TRANSFER LAYER 101 directly covers the top of the image-receiving layer 103a on an ink-jet image-receiving paper 103 after recording and IS THEN applied onto the image-receiving layer 103a by pressurization and/or fusion.

[0006] As shown in FIG. 3C, the base material ~~layer~~ FILM 102 is peeled off from the transfer layer 101 after the transfer layer is applied onto the recorded image, and the transfer layer 101 alone is left as a protective layer on the image-receiving layer 103a.

[0007] The principal problem of the construction

comprising a transfer layer 101 and a base material film 102, as shown in FIGS. 3A, 3B and 3C, is high cost. In a laminating treatment as ~~mentioned~~ DISCUSSED above, ~~a base material film comprising a heat resistant material is necessary for~~ the base material film 102 MUST BE COMPRISED OF A HEAT RESISTANT MATERIAL on which a resin layer to be transferred by heat and pressure adhesion on the recording side is formed by coating. ~~In this film, not only heat resistance but~~ IN ADDITION, THIS BASE MATERIAL FILM 102 MUST EXHIBIT flatness sufficient for giving the gloss of a protective film after the transfer ~~is also required, thus resulting in high cost.~~ The cost of this base material film 102 ~~has a much greater weight~~ IS HIGHER than that of EITHER a transfer material ~~remaining~~ WHICH REMAINS as a final product, or ~~that of~~ A coating of a transfer layer. SOME Sufficiently stable and deformation-free raw materials ~~of~~ FOR a protective layer, WITH ~~under~~ conditions assumed for ~~the~~ thermal transfer, AND IN WHICH PREANNEALING CONTROLS THERMAL SHRINKAGE, include PET film, polyamide film, AND polyimide film, ~~and so on with~~ IN EACH OF THESE, PREANNEALING CONTROLS thermal shrinkage ~~controlled by preannealing~~ BUT EACH OF THESE MATERIALS IS OF ~~but any of them is a~~ high-cost ~~material~~. ~~With such a constitution~~, AND THUS a wide variety of LOW-COST, GENERAL PURPOSE ~~applications truly low in cost and highly general in purposiveness~~ APPLICATIONS THAT ARE HIGH are difficult to create.

[0008] The second problem of this ~~constitution~~ CONSTRUCTION ~~lies in~~ IS that the base material film 102 becomes ~~a used~~ waste ONCE USED. ~~From the viewpoint of~~ TO MINIMIZE processing cost, coating of ~~a~~ THE transfer layer 101 is ordinarily executed on a wide roll before slitting. ~~Thus,~~ THUS, recycling of used base

material film 102 cannot be directly performed. ~~Supposing that~~ IF used ~~basic~~ BASE MATERIAL film 102 ~~are~~ WERE WAS recycled, ~~they~~ IT would be done on the ~~level of raw materials~~ RAW MATERIAL level. Thus, ~~it~~ THERE WOULD BE LABOR costs ~~labor for~~ FOR collecting and recycling them, IN ADDITION TO EXPENSES INCLUDING ~~Besides~~ a mechanism for rewinding a film after the image transfer in an apparatus, a space for ~~disposing~~ housing the mechanism, AND a power source OR CONTROL SYSTEM for moving the mechanism ~~or control system and so on are necessary~~. ~~In a case where~~ IF a laminate material has been cut, winding is unnecessary, but a mechanism for carrying used ~~basic~~ BASE MATERIAL films 102 and accumulating ~~them~~ IT in a predetermined space is still necessary.

[0009] The third problem of this ~~constitution lies in~~ CONSTRUCTION IS that the function of a protective layer transferred and formed varies according to ~~the~~ THESE FACTORS INCLUDING physical property IES, surface property IES, AND thickness ~~or the like~~. These especially affect the glossiness, the adhesion of a film and the bubble releasability ~~to a great extent~~. ~~Originally~~, the transfer process of a glossy protective layer is a complicated process ~~in~~ TO which many parameters contribute, ~~so that~~ AND THE addition of such ~~an~~ influential variable factors is unfavorable ~~to the stability of phenomena~~.

SUMMARY OF THE INVENTION

[0010] It is ~~one~~ AN object of the present invention to provide an image forming process and an image forming

apparatus capable of solving the problems mentioned above, ~~and~~ WHILE forming ~~an~~ A GLOSSY image ~~good in glossiness~~ at A low cost and free of used wastes.

[0011] An image forming process according to the present invention comprises the steps of conducting recording on a recording medium with an image-receiving layer and laminating a thermoplastic film onto the image-receiving layer to smooth the surface of the thermoplastic film by heating and pressurizing means.

[0012] An image forming apparatus according to the present invention comprises: an ink-jet head for conducting recording on a recording medium, a laminating section for laminating a thermoplastic polymer onto a recording medium on which recording has been conducted, and ~~heating and pressurizing means~~ A MEANS for heating and pressurizing the thermoplastic film to smooth the surface.

[0013] In the present invention, a thermoplastic resin film ~~alone~~ is laminated without use of a base material film, ~~that~~ AS has been ~~heretofore~~ PREVIOUSLY used, ~~and~~ ADDITIONALLY, the surface of a protective layer is smoothed during the lamination, ~~so that the cost can be~~ RESULTING IN A COSTS reduced and ~~a~~ glossy ~~fine~~ recorded image ~~can be obtained~~.

[0014] ~~Besides~~ FURTHER, BY ELIMINATING THE BASE MATERIAL FILM, AND A ~~a film itself is laminated and heat from a~~ APPLIES HEAT heating means ~~is~~ directly ~~transmitted~~ APPLIED TO THE LAMINATED FILM, ~~not by way of a base material film,~~ thereby reducing the thermal load of the apparatus ~~or the like~~.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is an illustration of ~~one~~ AN example of an image forming apparatus according to the present invention.

[0016] FIGS. 2A and 2B are illustrations of ~~one~~ AN example of a device for manufacturing a thermoplastic film used in the present invention.

[0017] FIGS. 3A, 3B and 3C are illustrations of ~~one~~ AN example of A method for laminating a laminate film with a base material attached.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] In the apparatus shown in FIG. 1, recording media 2-1 and 2-2, different in size, are fed from storing cassettes 1-1 and 1-2 by means of first and second feed rollers 3-1 and 3-~~2~~2. Furthermore, through conveyance guides 7-1 and 7-2, rollers 4, a conveyance guide 8, rollers 5 and a conveyance guide 9, ~~they~~ RECORDING MEDIA 2-1 AND 2-2 arrive at an ink-jet recording head 12. Here, in accordance with an image signal from unshown image reader means, images are recorded on the image-receiving layer of the recording media 2-1 and 2-2. The INK-JET recording head 12 is composed of so-called multi-heads arranged in a full line, for example, nearly perpendicular to the recording media 2-1 and 2-2, i.e. ~~vertical~~ perpendicular to the paper plane in FIG. 1. In this ink-jet recording, the recording media 2-1 and 2-2 are sucked to a porous

guide plate 14 by a suction fan 13 to retain ~~their~~ the planarity of the recording media and ~~keep their~~ maintain an established gap ~~to~~ with the recording head 12 ~~best~~.

[0019] ~~Furthermore~~, then, the recording media 2-1 and 2-2 after recording are conveyed through a conveyance guide 10, conveyance rollers 6 and a conveyance guide 11 to a laminating section.

[0020] ~~On the other hand~~, further, a long-scale thermoplastic resin film 22 is wound onto a drum-shaped thermoplastic resin film feed section 21 ~~in the shape of a drum~~. This thermoplastic resin film 22 has a width corresponding to a length perpendicular to the conveying direction of the recording media 2-1 and 2-2. This thermoplastic resin film 22 is fed from the feed section 21 through feed rollers 23, a cutter 24, conveyance rollers 25 and conveyance rollers 26 where it overlaps with the recorded recording media 2-1 and 2-2 ~~after recording~~ by means of rollers 27. ~~Besides~~, the thermoplastic resin film 22 is then cut ~~at~~ to a desired length ~~position~~ by means of the cutter 24.

[0021] ~~Furthermore~~, the overlapped portions of recording media 2-1 and 2-2 are ~~both of them overlapped by means of~~ ~~the rollers 27~~ thermoplastic resin film 22 are conveyed to pressurizing roller 28 ~~containing~~ which contains a heater 29 ~~built in and~~ then they are then heated and pressurized for adhesion. ~~Namely~~, more specifically, ~~onto the image-receiving layer of the recording media 2-1 and 2-2~~, the thermoplastic resin film 22 is laminated and then bonded onto the image-receiving layer of the recording media 2-1 and 2-2. The laminated recording media 2-1 and 2-2 are then discharged through rollers 32 to a discharge tray 33.

[0022] ~~Here,~~ when smoothing the surface of the protective layer ~~for~~ FOR improv~~e~~ING ~~the~~ glossiness of images, the pressurizing rollers 28 serv~~ing~~E as heating and pressurizing means ~~smooths~~ TO SMOOTH the surface on the side in contact with the thermoplastic resin film 22. In order to obtain glossy images, the surface roughness of the pressurizing rollers is preferably about 3 μm or less in terms of Ra, and ~~much~~ more preferably about 1.5 μm or less.

[0023] In the present invention, because of directly determining the glossiness of the transfer protective layer, ~~,~~AND accordingly, of recorded images~~,~~, the surface glossiness of THE rollers is an important factor. This glossiness ~~will vary~~ VARIES WITH IMAGE REQUIREMENTS ~~depends on that of images required,~~ but A ~~generally is preferably~~ GLOSSINESS equal to or greater than 10% at an incident angle of 20° and ~~is~~ equal to or greater than 70% at an incident angle of 75° IS GENERALLY PREFERRED.

[0024] ~~Besides,~~ IN ADDITION, the temperature ~~of heating~~ SUPPLIED by THE heating and pressurizing means ~~has to be determined appropriately~~ WILL VARY WITH DIFFERENT ~~COMPOSITIONS~~ ~~depending on material~~ MATERIAL COMPOSITIONS of ~~a~~THE thermoplastic resin film 22, but ~~is preferably in the~~ A range of 60°C to 220°C IS ordinarily PREFERRED.

[0025] ~~T~~The surface material ~~of~~ HEAT RESISTANT RUBBER IS PREFERRED FOR THE ~~this~~ pressurizing roller~~s~~ ~~pair~~ 28 on the side of ~~a~~THE thermoplastic resin film ~~is~~ ~~preferably heat resistant rubber~~. With a metal roller, once flaws are generated on the surface, their shapes are transferred, but ~~they are closed by~~ BY APPLYING pressure TO ~~in~~ a

material ~~of rubber~~, ~~thus improving the~~ durability is significantly improved. Furthermore, ~~from the viewpoint of mold releasability~~, silicon rubber is preferred for mold releasability ~~and~~ applying traces of silicon oil is also effective ~~significantly in point of~~ maintaining and improving the mold releasability.

[0026] Devices used for forming a protective layer ~~used~~ in the present invention are not limited to the example shown in FIG. 1. ~~For example~~, a charged drum is used as an intermediate carrier and a device ~~so~~ arranged so as to push this charged drum ~~wrapped with a~~ wraps the thermoplastic film 22 therearound to the recording media 2-1 and 2-2 ~~can be also employed.~~ (sic)

[0027] Any thermoplastic film which can be laminated on a recorded image-receiving layer of a recording medium may be employed as the thermoplastic resin films ~~used~~ in the present invention ~~without any limitation.~~ Thermoplastic resin films having preferable characteristics for lamination such as transparency, breaking strength and melting point have to be appropriately selected for use. Specifically, films of vinyl chloride-vinyl acetate copolymer, polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyesters, polyvinyl alcohols, polyamides, cellulose acetate, polycarbonates, polyvinyl butyral, vinylidene chloride or the like can be utilized.

[0028] ~~Besides~~, also, it is ~~preferable~~ preferred either that the glass

transition point of ~~a~~ THE thermoplastic resin film is lower than that of a binder resin of an image-receiving layer in a recording medium or that the film-forming temperature of ~~a~~ THE thermoplastic resin film is lower than that of a binder resin of an image-receiving layer in a recording medium. ~~respectively~~

[0029] The thickness of a thermoplastic resin film may be determined ~~appropriately~~, SUCH but ~~is~~ IT SHOULD preferably BE OF such thickness that the uneveness of the surface of the image-receiving layer in a recording medium does not appear on the surface of the thermoplastic resin film. ~~to be specific, it is preferably in the~~ SPECIFICALLY, A range of 2 to 40 μm IS PREFERRED.

[0030] ~~Besides~~, FURTHER, a thermoplastic resin film may be composed of a laminate of different thermoplastic polymer layers. In this case, ordinarily, the glass transition point or film-forming temperature varies among the thermoplastic polymer layers. Thus, a thermoplastic layer ~~much~~ SIGNIFICANTLY lower in glass transition point or film-forming temperature may be laminated onto the image-receiving layer. ~~And~~ ALSO in this case, the thickness of a thermoplastic polymer layer on the laminated side ~~to~~ OF the image-receiving layer ~~is~~ SHOULD preferably BE OF such thickness that the uneveness of the surface of the image-receiving layer does not appear on the surface of the thermoplastic resin film. ~~to be specific, it is preferably in the~~ SPECIFICALLY, A range of 1 to 20 μm IS PREFERRED FOR ~~and~~ FOR SUCH A THERMOPLASTIC POLYMER LAYER THICKNESS,

~~Besides~~ WHILE the total thickness of ~~of~~ THE thermoplastic resin film is preferably in the range ~~of~~ BETWEEN 2 ~~to~~ AND 40 μm.

[0031] By ~~setting~~ USING A POLYMER MATERIAL WITH A ~~HIGH~~ LOW GLASS TRANSITION POINT FOR the polymer layer on the side directly laminated onto an image-receiving layer, ~~to a material low in glass transition point~~ a resin can be ~~so~~ SO arranged as to firmly intrude into concave portions of an uneven image-receiving layer, ~~on the other hand~~ AND CONVERSELY, BY ADDITIONALLY ~~by~~ using a polymer material ~~high in~~ WITH A HIGH glass transition point and molecular weight for the layer on the opposite side, the surface hardness of the laminate layer can be enhanced. ~~Besides~~, such A MULTIPLE LAYER composition ~~of two layers or more~~ is ALSO advantageous ~~also from the viewpoint of~~ FOR preventing ~~the~~ inter-layer fusion in the stock of a thermoplastic resin film WHICH IS wound in the shape of a roll.

[0032] FIGS. 2A and 2B are schematic illustrations ~~exemplifying~~ a process for manufacturing a thermoplastic resin film used in the present invention.

[0033] FIG. 2A shows an example of manufacturing a monolayer thermoplastic resin film. As shown in FIG. 2A, a monolayer thermoplastic resin film is obtained by supplying a thermoplastic resin material from a dye coating head 51 to a casting roll 52 and winding a shaped film on a winding roll 53. By using a casting roll 52 in this manner, the film surface is well smoothed, THIS RESULTING IN ~~and~~ images after the formation of a protective layer FURTHER IMPROVED IN GLOSSINESS ~~further improves in glossiness~~.

[0034] FIG. 2B shows an example of manufacturing a double

layer thermoplastic resin film. As shown in FIG. 2B, a double layer thermoplastic resin film is obtained by supplying a thermoplastic resin material from a dye coating head 51 to a casting roll 52, ~~further~~ coating a second layer by means of a micro gravure coating head 54, drying the coat in a drying furnace 55, and winding the shaped film on a ~~winder~~ WINDING roll 53.

[0035] The examples shown in FIGS. 2A and 2B are ~~so~~ arranged ~~as~~ to wind a manufactured thermoplastic resin film in the shape of a roll and laminate this rolled thermoplastic resin film onto an image-receiving layer installed at the supply section 21 of the laminating apparatus shown in FIG. 1. ANOTHER ARRANGEMENT ~~a thermoplastic resin film may also be so arranged as~~ COULD to be continuously ~~supplied~~ A THERMOPLASTIC RESIN FILM from the casting roll 52 to the apparatus shown in FIG. 1 without being wound in the shape of a roll.

[0036] The image-receiving layer of a recording medium used in the present invention is mainly composed of porous inorganic particles and binder resin, ~~where~~ SUCH THAT 30 to 100 parts by weight, BUT preferably 50 to 500 parts by weight of binder resin, is employed with respect to 100 parts by weight of porous inorganic particles.

[0037] ~~As to~~ FOR porous inorganic particles, PREFERRED ARE those containing a large amount of pores having 3 to 30 nm diameter in the structure ~~are preferable~~, especially DESIRABLE ARE those having large pore density near the particle surface ~~are~~

~~preferable~~. Furthermore, ~~from the viewpoint of~~ FOR obtaining a sufficient ink absorption rate, ~~or the like~~, the specific surface area of porous inorganic particles is preferably 50 m^2/g or larger. ALSO ~~Furthermore~~, FOR ~~in use of~~ high-speed ~~printing~~ ink-jet printers, the image-receiving layer of a recording medium preferably contains A MINIMUM OF 50% by weight ~~or more of~~ porous inorganic particles with ~~the~~ A specific area of $100m^2/g$ or greater ~~from the viewpoint of~~ FOR preventing the overflow of ink, ~~or the like~~.

[0038] FURTHER, The porous inorganic particles endowed with such an ink solvent absorptivity and dye-molecule absorptivity preferably ~~take on~~ ARE white IN color. ~~Further, As to the~~ materials comprising porous inorganic particles having such characteristics, INCLUDE metals such as aluminum, magnesium and silicon, ~~and~~ AS WELL AS METAL oxides, hydrates, AND carbonates, ~~or the like of metals can be exemplified~~. Above all, synthetic silica is particularly PREFERRED ~~preferable~~ DUE TO ITS ~~on account of~~ excellency in all the characteristics mentioned above, established USE IN industrial production processes, inexpensiveness, and stability.

[0039] With an image-receiving layer comprising a mixture of such inorganic particles and an organic binder resin, ~~not quite~~ NOT QUITE small diameter ~~off~~ inorganic particles ~~is~~ ARE ~~not~~ PREFERRED ~~preferable from the viewpoint of~~ FOR ink absorptivity, ~~or the like~~. In many cases, inorganic particles in the range of 0.1 to 10 μm in diameter are employed and not

sufficiently small relative to the wavelength of light. Thus, a matted appearance results from ~~so that~~ light scattering takes place on the surface ~~to show a matted appearance~~. With ~~Among them~~ some of these particles, ultrafine particles in the range of 0.1 to 1 μm in diameter can sometimes reduce matting and provide a glossy surface ~~rather reduced in matt in some cases~~, but usually, a secondary aggregation of particles occurs, so that the suface can not be sufficiently smoothed ~~so much~~. ~~Besides~~, Also, if a dispersant is added to the coating liquid ~~for the purpose of~~ to prevent ~~ing the~~ aggregation, the absorptivity of ink ~~or~~ and/or the stability of dye molecules are often damaged.

[0040] For these reasons, the resulting surface of a recording medium containing such porous inorganic particles in which a high-speed absorptivity of ink and a coloring stability of dyes have been ~~investigated~~ desired is normally matted. The present invention displays considerable meritorious effects ~~in the case of~~ for using a recording medium containing such image-receiving layers.

[0041] Hereinafter, examples of the present invention will be described.

Example 1

[0042] Two parts of binder resin emulsion (Takamatsu Yushi; NS120-XK) was added to one part of silica (Mizusawa Chemical Industries; Mizukasil P-50). Thereafter, the mixture was dispersed to prepare a coating liquid ~~so that~~ in which the solid content became 20% by weight. This coating liquid was then coated and dried onto a

fine paper of 186 g/m² ~~by means of~~ USING a slot-dye coater ~~so~~ ~~that a film after the~~ AFTER drying THE FILM became 30 µm thick ~~to form~~ ~~an~~ image-receiving layer.

[0043] Next, an 8 µm thick thermoplastic resin film made of vinyl chloride-vinyl acetate copolymer was used ~~to carry out~~ FOR ink-jet recording and the formation of a protective layer ~~by means of~~ FOR THIS the apparatus shown in FIG. 1 WAS USED. The film-forming temperature of the film material was 60°C. The temperature of pressurizing rollers 28 having a silicon rubber surface during lamination was set to 140°C and the glossiness of the pressurizing roller 28 on the side of the thermoplastic resin film was set to 80% at an incident angle of 75°. As a result, recording images ~~excellent in glossiness~~ EXCEPTIONALLY GLOSSY ~~could be~~ WERE obtained.

Comparative Example 1

[0044] The same vinyl chloride-vinyl acetate copolymer as used in Example 1 was coated on a 38 µm thick polyethylene terephthalate film with the same thickness, thereby preparing a film with a base material as shown in Figs. 3A to 3C. The unevenness of the polyethylene terephthalate film was the same as that of the pressurizing rollers used in Example 1. Using this film, ink-jet recording and the formation of a protective layer were carried out as in Example 1, ~~and~~ BUT three times the heating energy of that in Example 1 was required ~~in order~~ to obtain the same glossiness as

in Example 1.

[0045] As clearly seen from the results of Example 1 and Comparative Example 1, the present invention does not use a film with a base material prepared by laminating a material for lamination onto a heat resistant film as in Comparative Example 1, but directly laminates only a material for lamination using rollers by heat and pressure adhesion which achieves high thermal efficiency and makes it possible to obtain finally glossy recorded images at a low cost.

Example 2

[0046] Except for the following, ink jet recording and formation of a protective layer was carried out as in Example that a thermoplastic resin film comprising two layers of a 3 μm thick layer made of low molecular weight acrylic resin and a 10 μm thick layer of vinyl chloride-vinyl acetate copolymer was used, the temperature of pressurizing rollers 28 was set to 120°C and the side of vinyl chloride-vinyl acetate copolymer was brought into contact with the image-receiving layer. ink jet recording and formation of a protective layer were carried out as in Example 1, then similarly desirable good results were obtained.

[0047] In this example, it is important to fully plasticize the acrylic resin layer with by means of the pressurizing rollers 28. Thereby, the lower vinyl chloride-vinyl acetate copolymer layer is sufficiently dissolved into the upper acrylic resin layer, thus making so as to make the interface disappear. Therefore, and thus the density of

recorded images can be improved by eliminating the light scattering on the interface between the above two layers. ~~Besides~~ ALSO, the blocking of a relatively high Tg acrylic resin layer is prevented so that a highly uniform film is ~~completed~~ OBTAINED.

[0048] As described above, according to the present invention, a thermoplastic resin film without a base material is laminated and the surface of a protective layer is smoothed during laminating, so that a ~~good~~ DESIRABLY glossy protective layer can be formed at a low cost and without [used] waste.

[0049] Moreover, since a film itself is laminated and the laminated film does not have a base material, ~~heat from~~ A heating means ~~is~~ directly transmitted ~~so that~~ IS HEAT, THEREBY REDUCING THE thermal load of ~~an~~ THE apparatus ~~or the like is reduced~~.